

## Wildlife Services

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## Improving Rodenticides and Other Rodent Damage Control Methods



### Contact Information:

Dr. Gary Witmer,  
Research Wildlife Biologist  
NWRC Headquarters  
4101 LaPorte Avenue  
Fort Collins, CO 80521

Phone: (970) 266-6335  
FAX: (970) 266-6157  
Email:  
gary.w.witmer@aphis.usda.gov  
Website: [www.aphis.usda.gov/wildlifedamage/nwrc/](http://www.aphis.usda.gov/wildlifedamage/nwrc/)

### Groups Affected By These Problems:

- Conservationists
- Farmers
- Livestock producers
- Military bases
- Natural resource managers
- Urban citizens

### Major Cooperators:

- California Department of Food and Agriculture
- Connovation, Ltd., New Zealand
- Invasive Animal CRC, Australia
- Netafim, Ltd., Fresno CA
- SenesTech, LLC., Flagstaff AZ
- University of California, Davis CA
- U.S. Department of Defense

### National Wildlife Research Center Scientists Assess and Develop Methods to Manage Native Rodents or Eradicate Introduced, Invasive Rodents

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research organization devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and socially responsible methods, tools, and techniques.

Rodents occur worldwide and have adapted to most types of ecosystems. Rodents provide many important ecosystem functions and although most rodent species do not cause serious damage problems, a small number of species do. Rodents damage ripening crops, forestry and nursery trees, rangelands, ornamental plants, and property, including cables and irrigation pipes. They also consume and contaminate stored food, transmit diseases, and contribute to the decline of native flora and fauna on islands. Many tools are used to reduce rodent populations and mitigate damage. NWRC researchers develop and evaluate rodenticides, barriers, and other tools to eliminate or reduce the damage caused by native and invasive rodents.

### Applying Science and Expertise to Wildlife Challenges

**Improving Rodenticide Safety and Efficacy.** — Rodents cause substantial amounts of damage and losses of foodstuffs around the world. While various methods are used to reduce these losses, rodenticides remain the most important tool in the toolbox. The future use of rodenticides will be impacted by manufacturing and registration costs, concerns about toxicity levels for non-target animals, potential hazards to children, reduced effectiveness of some formulations, and humaneness to the targeted rodents. Very few new developments in rodenticides have emerged over the last several decades. NWRC researchers are beginning to address this issue. Recent studies on new materials and formulations including sodium nitrite, lower concentrations of zinc phosphide, and two-active ingredient formulations (cholecalciferol plus diphacinone) show promise for controlling a number of rodent species. For instance, by changing bait formulations, NWRC scientists achieved similar efficacy to existing formulations but with lower rodenticide zinc phosphide concentration (0.5 percent versus 2 percent). In other studies, sodium nitrite and zinc phosphide have been successfully encapsulated to increase palatability and reduce bait shyness. Such modifications to active ingredients help to improve the safety and efficacy of rodenticides.

**Detecting and Preventing Mouse Invasions.** — Invasive house mice pose a threat to the native flora and fauna of islands, causing significant damage wherever they are introduced. A better understanding of how house mice behave when they are first introduced to a new environment would help managers develop effective biosecurity techniques to protect against new invasions. To address this issue, NWRC researchers conducted a controlled laboratory experiment that simulated an invasion by wild house mice into a new environment. Researchers quantified and compared the reactions of these mice to various odors and other attractants including food, shelter, water, and other mice. The results showed that the most common immediate reaction of the mice was to seek shelter in a den box. Secondly, the mice were interested in food scents, particularly cheese, bacon grease, almond extract, and peanut butter. Females investigated male urine and fecal odors more often than males investigated female odors. Based on the findings, researchers surmise that a secure den box with certain food and mouse odors might entice and hold house mice in a restricted area for a short time in a new environment. If handled properly, this arrangement could be used for early detection and response to new invasions of house mice.

**Protecting Seedlings From Rodent Damage.** Solid waste landfills are common in urbanized and industrialized regions of the world. If designed, managed, and restored properly, they can be reclaimed and converted to useful land areas. However, restoring trees and shrubs at landfill sites can be difficult when animal damage occurs. NWRC researchers evaluated how two changes to habitat (mowing and a pea-gravel barrier) and rodenticides could protect tree seedlings from meadow voles at restored landfill sites in Brooklyn, NY. The treatment sites included either plots with mowed grass or a ring of pea gravel about 3 inches deep around tree seedlings. The documented damage rodents caused to tree seedlings in the plots-including killing them-ranged from 40 to 73 percent, regardless of species. Substantial losses occurred regardless of the



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treatment used, although there were fewer losses at sites with pea-gravel barriers. While the pea-gravel treatment reduced seedling losses by approximately 55 percent, more research is needed to identify efficient ways to reduce seedling losses to rodents in restoration plantings.

#### **Selected Publications:**

Witmer, G.W. Evaluating habitat manipulations and rodenticides to protect seedlings from rodent damage at restored landfills in New York. 2014. Restoration Ecology 22(2):178-184. doi:10.1111/rec.12056.

Witmer, G., K. Horak, and R. Moulton. 2014. New rodenticides: an update on recent research trials. Proceedings of the Wildlife Damage Management Conference 15:79-85.

Witmer, G.W., N.P. Snow, and R.S. Moulton. 2014. Responses by wild house mice (*Mus musculus*) to various stimuli in a novel environment. Applied Animal Behaviour Science 159:99-106. doi: 10.1016/j.applanim.2014.07.007.

Witmer, Gary W., N.P. Snow, and R.S. Moulton. 2013. The effects of vitamin K1-rich plant foods on the efficacy of the anticoagulant rodenticides chlorophacinone and diphacinone, used against Montane voles (*Microtus montanus*). International Journal of Pest Management 59(3):205-210. doi: 10.1080/09670874.2013.816453

Witmer, G.W., R.S. Moulton, and R.A. Baldwin. 2014. An efficacy test of cholecalciferol plus diphacinone rodenticide baits for California voles (*Microtus californicus* Peale) to replace ineffective chlorophacinone baits. International Journal of Pest Management. 60(4):275-278. doi: 10.1080/09670874.2014.969361.

#### **Major Research Accomplishments:**

- By changing bait formulations, WS scientists were able to reduce the amount of the rodenticide zinc phosphide (from 2 percent to 0.5 percent) in baits while maintaining high efficacy levels.
- Early detection of house mice may help to prevent the establishment of these invasive rodents on islands and in other areas. WS research on the exploratory nature of house mice found that a secure den box with certain food and mouse odors might entice and hold house mice in a restricted area for a short time in a new environment.
- WS research found the use of pea-gravel barriers around tree seedlings reduced seedling losses due to vole damage by approximately 55 percent.